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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/690,084	10/20/2003	Daniel A. Koos	NOVLP068/NVLS-000818	4873

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EXAMINER

VINH, LAN

ART UNIT PAPER NUMBER

1765

DATE MAILED: 07/25/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

## Office Action Summary

Application No.

10/690,084

Applicant(s)

KOOS ET AL.

Examiner

Lan Vinh

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☒ Responsive to communication(s) filed on 15 May 2006.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☒ Claim(s) 1-6 and 8-76 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☒ Claim(s) 25-27 and 43-56 is/are allowed.
- 6) ☒ Claim(s) 1-6, 16-24, 28, 29, 34-42, 57-60 and 62-68, 70-75 is/are rejected.
- 7) ☐ Claim(s) 8-15, 30-33, 61, 69 and 76 is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

### Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.

### Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)  
Paper No(s)/Mail Date \_\_\_\_\_.
- 4) ☐ Interview Summary (PTO-413)  
Paper No(s)/Mail Date. \_\_\_\_\_.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: \_\_\_\_\_.

## **DETAILED ACTION**

### ***Response to Arguments***

1. Applicant's arguments, see pages 10-11 of the response, filed 5/15/2006, with respect to the rejection(s) of claim(s) 1, 38 under 35 U.S.C 102(b) as being anticipated by Uzoh et al (US 6,355,153) have been fully considered and are persuasive.

Therefore, the rejection has been withdrawn. However, upon further consideration, a new ground(s) of rejection of claims 1, 38 is made in view of Modak (US 2003/0003711) that discloses a step of "wet etching metal from.....with a wet etching solution"

Applicant's arguments, see page 12 of the response, with respect to the rejection of claim 25 under 35 U.S.C 103(a) have been fully considered and are persuasive. The rejection has been withdrawn.

Applicant's arguments, see page 13 of the response, with respect to the rejection of claims 43, 48 under 35 U.S.C 102(e) have been fully considered and are persuasive. The rejection has been withdrawn.

Applicant's arguments, see pages 13-14 of the response, filed 5/15/2006, with respect to the rejection(s) of claim(s) 57, 67 under 35 U.S.C 103(a) as being unpatentable over Ma and Jun et al have been fully considered and are persuasive. Therefore, the rejection has been withdrawn. However, upon further consideration, a new ground(s) of rejection of claims 57, 67 is made in view of Sasaki et al (US 5,770,095)

***Claim Rejections - 35 USC § 102***

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for a patent.

3. Claims 38-42 are rejected under 35 U.S.C. 102(a) as being anticipated by Modak (US 2003/0003711A1)

Modak discloses a method for forming a semiconductor device on a substrate having a layer of metal 105 and dielectric layer 101. The method comprises the steps of:

receiving the substrate containing the layer of metal 105 of copper and dielectric 101 (page 2, paragraph 0014), wet etching metal from the substrate from a position above an upper level of dielectric to a position below the upper level of exposed dielectric in the layer by contacting the substrate with an acid/wet etching solution (page 2, paragraph 0017, 0019, fig. 1c); and forming a capping layer 107 (TiN) by PVD on at least exposed metal portions of the substrate (page 2, paragraph 0020; fig. 1d)

***Claim Rejections - 35 USC § 103***

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the

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invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

5. Claims 1-6, 16, 18-20, 24, 28-29, 34-37 are rejected under 35 U.S.C. 103(a) as being unpatentable over Modak (US 2003/0003711A1) in view of Uzoh et al (US 6,355,153)

Modak discloses a method for forming a semiconductor device on a substrate having a layer of metal 105 and dielectric layer 101. The method comprises the steps of:

receiving the substrate containing the layer of metal 105 of copper and dielectric 101 (page 2, paragraph 0014), wet etching metal from the substrate from a position above an upper level of dielectric to a position below the upper level of exposed dielectric in the layer by contacting the substrate with an acid/wet etching solution (page 2, paragraph 0017, 0019, fig. 1c); and forming a capping layer 107 (TiN) having a thickness of 50 nm/500 angstroms by conventional PVD process on at least exposed metal portions of the substrate (page 2, paragraph 0020; fig. 1d)

Unlike the instant claimed invention as per claim 1 Modak fails to disclose forming the capping layer by electroless deposition

Uzoh discloses a method for fabricating a chip interconnect comprises a step of forming a metal capping layer by electroless deposition (col 8, lines 5-35)

One skilled in the art at the time the invention was made would have found it obvious to modify Modak method by forming the capping layer by electroless deposition in view of Uzoh teaching because according to Uzoh a conductive layer may be deposited by electroless or CVD methods (col 8, lines 5-9)

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Unlike the instant claimed invention as per claim 4 Modak fails to disclose forming the capping layer comprises cobalt. Uzoh also discloses forming a cobalt capping layer (col 8, lines 53-55). One skilled in the art at the time the invention was made would have found it obvious to substitute Modak TiN capping layer with cobalt in view of Uzoh teaching because Uzoh discloses that the barrier/capping layer may be TiN or CoWP material (col 1, lines 38-41)

The limitations of claims 2-3, 5, 6, 16, 24, 36, have been described above

Regarding claim 18, Modak is silent about etching the metal layer with an acidic solution produce insoluble metal oxide

Regarding claims 28-29, Modak discloses performing a cleaning step to clean the exposed metal portion prior to forming the capping layer (page 2, paragraph 0019)

Regarding claim 34, 35, Modak discloses a step of forming a layer on the capping layer by using a process that is performed at an increased temperature and forming a nitride layer (page 2, paragraph 0021)

Regarding claim 37, fig. 1b of Modak shows the metal layer 106 covering the upper level of dielectric layer 101

6. Claims 17, 21-22, 23 are rejected under 35 U.S.C. 103(a) as being unpatentable over Modak (US 2003/0003711A1) in view of Uzoh et al (US 6,355,153) and further in view of Sasaki et al (US 5,770,095)

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Modak as modified by Uzih has been described above. Unlike the instant claimed inventions as per claims 17, 21-23, Modak and Uzoh fail to disclose that the etching solution comprises a surfactant, a corrosion inhibitor and a complexing agent

Sasaki discloses a method for forming a film comprises the step of etching using an etching solution comprises etching agents such as acid, peroxide/complexing agents, glycine/surfactant, BTA/corrosion inhibitor (col 4, lines 1-10, col 8, lines 11-25)

Since Modak is concerned with a step of etching the metal layer of Cu, one skilled in the art at the time the invention was made would have found it obvious to modify Modak and Uzoh by using the etching solution comprises a surfactant, a corrosion inhibitor and a complexing agent as per Sasaki because Sasaki discloses that these etching agents are particularly preferably to be used when Cu is employed as the material containing of a metal (col 4, lines 8-12)

7. Claims 57-60, 62-68, 70-75 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sasaki et al (US 5,770,095) in view of Hasegawa et al (6,184, 124)

Sasaki discloses a method for forming a film on a substrate having a metal layer 25 or 32 and a dielectric layer 22. The method comprises the steps of :

receiving the substrate containing a layer of metal 32 (W or Cu) and a dielectric layer 22 (col 9, lines 15-35, col 12, lines 3-9), the substrate comprises the layer 32/overburden covering the dielectric field (fig. 7A)

partially planarizing the layer 32/overburden (fig. 7B)

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polishing/etching metal to remove the remaining metal/ portion of metal from the substrate by spraying the substrate with an aqueous/wet etching solution comprising peroxide/oxidizer, glycine/complexing agent/surfactant, (col 12, lines 3-20)

Unlike the instant claimed inventions as per claims 57, 67, 62, 75, Sasaki fails to disclose that the etching solution has a pH in a range of 5-12

Hasegawa disclose a method of making wiring comprises a step of using a wet acidic etching comprises acid and peroxide having a pH of 2 to 6.5

Hence, one skilled in the art at the time the invention was made would have found that Sasaki etching solution would have obviously had a pH of 2-6.5 in view of Hasegawa teaching because Hasegawa discloses that pH of wet etching by the acidic etchant is preferred within 2 to 6.5 (col 8, lines 60-67)

The limitations of claims 58, 60, 64, 68, 70, 73

Regarding claims 63, 71, Sasaki discloses forming a protection film on the surface of the etched metal (col 9, lines 40-45)

Regarding claims 65-66, 70, Sasaki discloses partially removing the layer 32 by CMP (col 10, lines 50-55)

Regarding claims 59, 74, Sasaki discloses that the solution containing BTA/corrosion inhibitor (col 12, lines 29-31)

***Allowable Subject Matter***



8. Claims 8-15, 30-33, 61, 69, 76 is objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

The following is a statement of reasons for the indication of allowable subject matter:

Regarding claim 8, the cited prior art of record fails to disclose or suggest a method of depositing a metal-containing capping layer wherein the etching solution oxidizes the metal of the substrate to a metal oxide, in combination with the rest of the limitations of claim 8

Regarding claim 30, the cited prior art of record fails to disclose or suggest a method of depositing a metal-containing capping layer comprises the steps of forming a metal nucleation layer on the exposed metal portions of the substrate by electroless deposition from a first solution comprising metal ions and forming a bulk metal layer on the metal nucleation layer by electroless deposition from a second solution comprising metal ions and a reducing agent that promotes electroless deposition on elemental metal surface, in combination with the rest of the limitations of claim 30

Regarding claims 61, 69, the cited prior art of record fails to disclose or suggest a method of etching metal comprises the step of etching with a etching solution having the specific claimed concentrations of hydrogen peroxide and glycine

Claims 25-27, 43-56 allowed.

The reasons for allowance of claims 25, 43, 48 have been discussed in paragraph 1

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9. Applicant's amendment necessitated the new ground(s) of rejection of claims 1, 38, 57, 67 presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

### ***Conclusion***

10. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Lan Vinh whose telephone number is 571 272 1471. The examiner can normally be reached on M-F 8:30-5:30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nadine Norton can be reached on 571 272 1465. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

A handwritten signature in black ink, appearing to be 'LV', is written above the typed name 'LV'.

LV

July 23, 2006